Forest Health Protection
Pacific Southwest Region

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To: Robyn Scibilio, Center Manager, Chico Genetic Resource and Conservation Center (FHP Report No. N15-01)

Subject: Trip report following site visits to Chico Genetics Resource and Conservation Center

At the request of Lisa Crane, Biological Science Technician, site visits were made to the Genetics Resource and Conservation Center in Chico on July 21 and 22, 2015. The objective was to look at current mortality in the ponderosa pine seed orchard.

Background

The Chico Genetic Resource and Conservation Center is located on 209 acres, in Chico, CA. Development started in 1904 when the site was assigned to the Agricultural Research Service for the purpose of plant breeding research and plant introduction from all over the world. The Forest Service acquired the station in 1974 and in 1976 the Center was officially declared the Chico Tree Improvement Center (CTIC). The program changed to development and production of genetically improved plant material for reforestation in the Pacific Southwest Region. In 1992, the center was renamed the Genetic Resource & Conservation Center (GRCC) to reflect the broader role of genetics in the management of forest ecosystems and the importance of germplasm conservation. Today, the GRCC produces genetically improved conifer seeds for reforestation and restoration. It also serves as a resource for research in plant genetics and forest health issues including insect behavior and disease resistance.

Lisa Crane contacted me on July 17, 2015, with a request to recommend treatment options for bark beetles and twig scales which she believed were causing branch flagging and mortality in an older ponderosa pine seed orchard. I set up a site visit for July 21 to identify the bark beetle and scale problems she had described and provide information accordingly.

The seed orchard identified was established circa 1978-1985; ponderosa pine grafts to compatible ponderosa pine root stock, from unidentified sources. These trees were visited previously by Dave Schultz and Pete Angwin in the early 2000s, and Pete identified Atropellis canker in several of the trees. The GRCC has had an Integrated Pest Management Plan in place since 2009. IPM in conifer seed orchards means that the control measure(s) the orchard manager selects for a certain pest depends on the actual need to control this pest in the first place, i.e. the degree of pest management is directly

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linked to the degree of damage that can be tolerated while still accomplishing the objective of producing viable seed.

Observations and Discussion

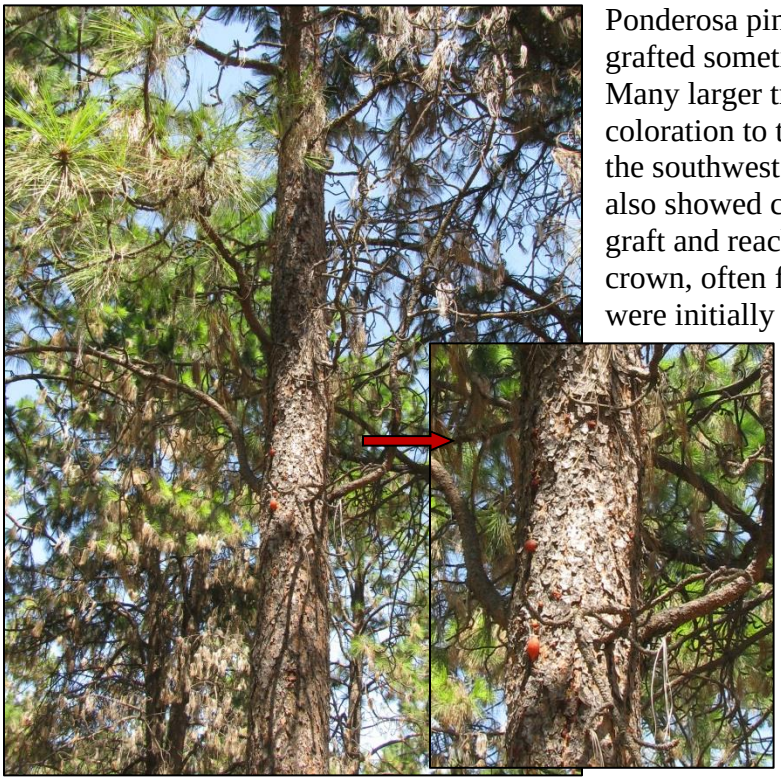

Figure 1. Pitch flow and balls on ponderosa pine at ponderosa pine seed orchard.

Ponderosa pines in the seed orchard were grafted sometime between 1978 and 1985. Many larger trees exhibited light orange coloration to the bark above the graft on the southwest face of the trees. These trees also showed copious pitch flow above the graft and reaching very high into the crown, often forming distinct balls that were initially thought to be pitch tubes associated with bark beetles (Figure 1). Many trees had branch flagging and some whole tree mortality that appeared to be occurring from the bottom up (Figure 2). I peeled some bark back where pitching occurred and found no evidence of bark beetles or other wood boring insects. I also found no evidence of scales on boles, branches, or needles. Many of the flagging branches appeared to have symptoms of Diplodia blight which is caused by the fungus *Sphaeropsis sapinea* (= *Diplodia pinea*). These symptoms included dead, resin-soaked terminal buds, shortened needles and in extreme cases, dead branches and whole tree mortality. I collected samples and conferred with my colleagues in Redding, Pete Angwin (plant pathologist, USFS) and Don Owen (forest health specialist, CalFire).

Figure 2. Branch flagging at ponderosa pine seed orchard.

After much discussion, we agreed that bark beetles and scales were not the cause of the problems at the seed orchard as was previously suspected. The cambium and underlying wood of dead trees that were cut into to look under the bark were very dry. We talked about other times that

similar dieback symptoms were documented, and thought that the problem might be drought-related. Don noted that during the extended drought in the late 1980s to early 1990s, he saw similar symptoms and a fair bit of tree mortality that was related to drops in the water table levels. A high water table can be a boon to tree growth, but it also limits the growth of roots to the upper levels of the soil. If the water table drops significantly, the trees can be left high and dry. That did not answer the pitching, but the main concern seemed to be the mortality occurring. It was concluded that if the trees were dying simply due to a drought-related lack of water, then the roots and lower portions of the bole would be dry. This would be relatively easy to confirm.

I returned the following day (July 22) with Pete Angwin to reassess the situation and confirm or reject the hypothesis. When Pete cut into the roots and lower bole of three of the pines with advanced dieback symptoms, he found that the cambium was moist and healthy and the phloem thick, indicating an abundance of water and refuting the drought hypothesis (Figure 3). We then used a lift to get high into the crown where most of the pitching and resin flow was occurring (Figure 4). Again, the cambium was moist and the

Figure 3. Moist, healthy cambium at the root collar of a pitching ponderosa pine.

Figure 4. Using a mechanical lift to inspect the mid-crown of a pitching ponderosa pine.

phloem was thick. However, wherever significant sap flow occurred, vertical cracks were found in the outer bark, and in the cases where sap flow was observed but the bark was intact, vertical cracks were found in the sapwood under the bark (Figure 5). Discussions with Robyn and Dennis (seed orchard technician) indicated that the watering of the trees was currently set to what is considered optimal based on past experience. Under these conditions, copious amounts of water are delivered from the well-established rootstock through the graft to the younger scion wood stem above. With unlimited water, the trees

grow unusually fast, even though their seed sources are not well matched to hot growing site at the Chico GRCC. However, while the cambium and sapwood of the trees are rapidly expanding, the outermost portions of the tree are also drying out and contracting due to the hot conditions that are prevalent in Chico in the summer. This tension between the rapidly expanding interior and contracting exterior causes cracks to occur, releasing copious amounts of pitch. Phil Cannon, USFS Pacific Southwest Region Regional Pathologist, has observed similar pitch responses in grafted off-site trees in several areas around the world, and described the phenomenon as similar to the cracking that occurs when wet leather is wrapped around a fixed-diameter pine and rapidly dried out. The pitching that is occurring in the pines at the seed orchard thus appears to result from a physical and physiological response to the growing conditions at the GRCC, not from an insect or disease infestation.

Figure 5. Cracked outer sapwood at the mid-crown level of a pitching ponderosa pine.

It thus appears that two things are going on in the pines at the seed orchard- pitching in the boles due to the watering and hot, dry conditions at the nursery, and flagging and dieback of terminal branches due to Diplodia blight. While discussing the situation, Robyn and Dennis said that the flagging and terminal dieback occurs almost every year. Chronic infection of Diplodia blight is unusual in native stands, but the combination of late spring rains, persistent fog in the winter and spring, and the off-site planting are perfect environmental and host conditions for Diplodia blight. Sporadic scattered tree mortality due to the recurring, repeated infections that have occurred over many years is therefore not particularly surprising. Control is possible with the timely application of a registered fungicide. However, in California, treatment of the disease with fungicides is extremely rare because it is very impractical. Application timing is critical- the fungicide mix (the 1981 Forest Insect and Disease Leaflet on Diplodia Blight of Pines mentions a 4-4-50 Bordeaux mixture of 4lb. copper sulfate, 4lb. hydrated lime and 50 gal. of water) must be applied in two treatments, one week apart, right when the buds are opening and expanding. In addition, treatments would have to be done every year, and the trees need to be completely covered. These limitations are described more fully in the California Dept. of Forestry and Fire Protection Tree Note #23 (Owen 1998). While I don't recommend fungicide treatment, if it does become considered, I'd strongly recommend that samples be sent to a diagnostic lab to confirm that the dieback is indeed caused by *Sphaeropsis sapinea*.

If you have any questions regarding this report and/or need additional information, please contact Cynthia Snyder at 530-226-2437 or Pete Angwin at 530-226-2436.

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References

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